Analysing the Creative Process through a Modelling of Tools and Methods for Composition in Hans Tutschku's *Entwurzelt*

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Abstract

The analysis of the creative processes involved in electroacoustic music may to a large extent rely on the thorough study of the technological tools used for the realisation of a musical work, both on the composition and on the performance sides. Understanding the behaviour and potential range of aesthetic results of such tools enables the musicologist to approach the studied work much beyond its final form, as presented on tape or as performed on a particular occasion: gaining knowledge on a wider technological context leads to considering the actual artistic decisions in the perspective of the potential outcomes that the composer and performer could face but not necessarily adopt. Hence, analysing an electroacoustic work on the basis of the study of its creative context, technological tools and compositional methods may constitute a useful approach to a better understanding of its related creative processes. However, the implementation of such an approach, mainly based on the hardware or software elements used during the creation of a given work, is not straightforward. First, it implies that the considered technologies are still in use and have not become irreversibly obsolete. In this matter, new performances of a work are good opportunities for such investigations, as they often provide a technical update and require a deep understanding of the composer's intentions. The musicologist also needs to have access to the resources, which may not be available without a direct contact with the composer. Assuming these conditions are reached, the musicological and organological studies can encounter another issue, particularly in the digital domain: the sources are not always presented under forms that are directly readable by the analyst, for instance with a specific programming language. Despite all these possible difficulties, many cases of technological tools lean themselves to an in-depth investigation, leading to relevant conclusions on some of the creative processes appearing in the field of electroacoustic music.

In the context of a common session of several analytical approaches to a same electroacoustic piece, Hans Tutschku's *Entwurzelt* for six singers and electronics (2012), this article focuses on the investigation and modelling of tools and methods of the compositional stage of the realisation of the work. During a performance of *Entwurzelt*, the electronic materials are simply triggered as events by one of the singers, without further interactivity – thus, the essential part of the research on the electroacoustic realisation aims at exploring the processes used during the compositional stage itself. As the electronics are used as an extension of the live vocal expression by the means of harmonic amplification and complex texturing, the tools for generation and processing of both symbolic representations and audio signals are

explored. Since the software tools that constitute the primary sources for our research were not directly designed to be used beyond their creative purposes, this talk presents software modelling implemented by the two authors to demonstrate the technological context in which Tutschku could compose *Entwurzelt*, emphasizing his creative methods and the decisions he could make upon a wider range of possible materials and processing techniques.

Introduction

Within the domain of electroacoustic music studies, the investigation of creative processes may to a large extent rely on a thorough study of the technological tools used for the realisation of a musical work, both on the composition and on the performance sides. Understanding the behaviour and potential aesthetic results of such tools enables the musicologist to consider the studied work much beyond its final form, as presented on tape or as performed on a particular occasion: gaining knowledge on a wider technological context allows for an evaluation of the actual artistic decisions in the perspective of the potential outcomes that the composer and performer could face but not necessarily adopt. Hence, analysing an electroacoustic work on the basis of the study of its creative context, technological tools and compositional methods may lead to a better understanding of its genesis and related creative processes.

This contribution discusses the application of such an approach, that we call "digital organology"[1], to Hans Tutschku's *Entwurzelt* for six singers and electronics (2012). It is implemented within a larger musicological framework, as part of a session composed by the *Analysis of Electroacoustic Music* working group of the French Society for Music Analysis (SFAM)[2] on the occasion of the EMS network conference in Berlin, proposing three different methods of analysis for the same work by Tutschku[3]. The two other contributions of this session are Pierre Couprie and Mikhail Malt's "Representation: From Acoustics to Musical Analysis" and Bruno Bossis and Laurent Pottier's "A Method For the Analysis of the Relation Between Symbolic Notation and Electroacoustic Textures In Hans Tutschku's *Entwurzelt*"[4]. In this paper, we present the materials available for an organological approach

[1] For a fuller account and references on our approach of digital organology, see our presentation at the previous EMS conference in Lisbon and its associated article: Alain Bonardi, Frédéric Dufeu, "How Can We Model Behaviours of Digital Instruments? Propositions in fuzzy logic from Philippe Manoury's works", in *Proceedings of the Electroacoustic Music Studies Network Conference (EMS13)*, Lisbon (Portugal), 2013, www.ems-network.org/IMG/pdf_ems13_bonardi_dufeu.pdf (last accessed 09/14).

[2] www.sfam.org (last accessed 09/14).

[3] The *Analysis of Electroacoustic Music* (Analyse de la musique électroacoustique) working group is funded by the French Society for Music Analysis for a duration of three years (2012-2015). Its six members are Alain Bonardi (Université Paris 8 Vincennes-Saint-Denis), Bruno Bossis (Université Rennes 2), Pierre Couprie (Université Paris-Sorbonne), Frédéric Dufeu (University of Huddersfield), Mikhail Malt (Ircam – Université Paris IV Paris-Sorbonne), and Laurent Pottier (Université Jean Monnet, Saint-Étienne). Over this period, the working group organises research events (Université Jean Monnet, Saint-Étienne, January 21st, 2013; University of Huddersfield, March 18th, 2014) and participates to international conferences (Journées d'Informatique Musicale, Université Paris 8, May 13-15th, 2013; EMS14 in Berlin). See http://ame.sfam.org (last accessed 09/14).

[4] Abstracts can be consulted on the EMS14 website: www.ems-network.org/ems14/2014abstracts.html (last accessed 09/14). The collective investigation of Hans Tutschku's *Entwurzelt* was started on the occasion of a workshop at the JIM 2013 conference. See Alain Bonardi, Bruno Bossis, Pierre Couprie, Frédéric Dufeu, Mikhail Malt, Laurent Pottier, "Atelier : Outils pour l'analyse de la musique électroacoustique", in *Proceedings of Journées d'Informatique Musicale (JIM 2013)*, Saint-Denis (France), 2013, pp. 199-200.

of the work, before discussing modelling perspectives for the investigation of its compositional processes, with a consideration of both the domain of symbolic representation and the manipulation of recorded sound.

1. Materials for an organological approach of *Entwurzelt*

Hans Tutschku's *Entwurzelt*[5] is a 16-minute work for six singers[6] and electronics, dedicated to the Neue Vocalsolisten Stuttgart[7], who created it at Theaterhaus in Stuttgart on December 12th, 2012. The composer introduces his work as follows:

> *Entwurzelt* searches for meaningful expressions in a language we don't know and reflects my interest in drama. The tight relationship between the live passages and the electronics creates a sound world, drawing us curiously into the discovery of its sense. The composition is not based on an existing text, rather an invented dialogue with hints to different idioms. The electronics are used to extend the vocal expressions of the live singers, to build harmony and complex sound textures, but they also serve at times as an element of surprise.[8]

Entwurzelt is divided in 20 sections, labelled A to T, with durations ranging from a few seconds to more than two minutes. During the performance, one of the singers triggers successively 112 prepared stereo sound files, ranging from 1.5 to 23.5 seconds, from an iOS device fitted with a simple application developed for the work. This electroacoustic part is projected from two small loudspeakers placed on the floor of the stage, in front of the singers. As explained in the technical note,

> there is no need for microphones nor additional loudspeakers in the concert hall. […] The speakers on the floor should be angled by approximately 45 degrees [upwards] so that the sound is not pointed directly to the audience but rather first bounces off reflective surfaces in the hall and therefore mixes more naturally with the sound [of the live singers]. It should not give the impression that the sounds are coming straight out of the speakers and a high degree of sonic fusion with the live singers should be obtained.[9]

During a performance of *Entwurzelt*, the electroacoustic materials are unprocessed. The real-time device only enables to adjust the triggering time of the successive sound files to the flexible tempo adopted by the live singers. When a new material is triggered, the previous one, if still playing, fades out. Thus, the intervention of the performers has very little influence on the electroacoustic part as heard by the audience. Research works in digital organology can approach the significance of the creative tools engaged both in the compositional process, as is typically the case with works for tape[10], and in the performance

[5] "*Entwurzelt*" means "deracinated".
[6] Soprano 1, soprano 2, mezzo-soprano, tenor, baritone, bass.
[7] Sarah Maria Sun (high soprano), Susanne Leitz-Lorey (lyric soprano), Truike van der Poel (mezzo-soprano), Martin Nagy (tenor), Guillermo Anzorena (baritone), Andreas Fischer (bass). Daniel Gloger (countertenor) is also a member of the Neue Vocalsolisten Stuttgart.
[8] Hans Tutschku, "*Entwurzelt* (*deracinated*)", work presentation webpage, www.tutschku.com/content/works-entwurzelt.en.php (last accessed 09/14).
[9] *Ibid*.
[10] See for instance Michael Clarke, "Jonathan Harvey's *Mortuos Plango, Vivos Voco*", in *Analytical Methods of Electroacoustic Music*, Mary Simoni (ed.), New York, Routledge, 2006, pp. 111-143; Olivier Baudouin, "A Reconstruction of *Stria*", *Computer Music Journal*, 31(3), 2007, pp. 75-81; Michael Clarke, "*Wind Chimes*: An Interactive Aural Analysis", in *Denis Smalley: Polychrome Portraits*, Évelyne Gayou (ed.), Paris, Ina-GRM, 2010, pp. 35-57.

aspects of pieces for real-time electronics[11]; despite the live nature of *Entwurzelt*, the investigation of the relationships between its technological tools and creation shall focus on the compositional side.

The presentation webpage dedicated to the work[12] contains several elements that are directly useful to the analyst. Along with commentaries by the composer, it includes two videos: the first one is the recording of the creation by the Neue Vocalsolisten in 2012; the second one is a simulation of the iOS application running through all the triggered events, which enables to listen to the electroacoustic part on its own. The webpage then presents the electronic setup and technical requirements, and includes a *modus operandi* of the software for rehearsals and live performance as well as a download link to the application itself. Finally, the score of *Entwurzelt*[13] can be downloaded as pdf. To complete these publically available documents, the *Analysis of Electroacoustic Music* working group asked Tutschku for further materials in order to undertake the first stage of its collective analytical work. The composer kindly provided the following sources: handwritten sketches for the structural chords and global form; screenshots of the final Nuendo session from which he assembled the sound files to be projected during the performance; a folder containing the final sound files themselves and another one containing, for most events, individual constitutive sound files. Additionally, Tutschku provided a PowerPoint file supporting a presentation of *Entwurzelt* and including further handwritten and printed sketches, along with several screenshots of PWGL patches[14]. In the two following sections of this article are presented analytical considerations regarding the symbolic representation-based materials and the sound files.

2. Symbolic representation-based materials and processes

Entwurzelt is harmonically based on three chords (figure 1) that are both used in the score and in the electroacoustic part. They highly contribute to the unity of the piece.

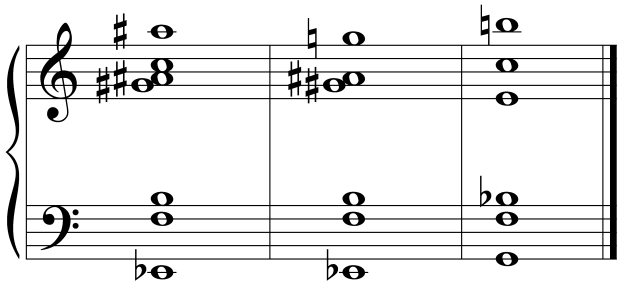

Figure 1. The three chords forming the harmonic ground of *Entwurzelt*

[11] See for instance Antoine Vincent, Alain Bonardi, Bruno Bachimont, "Préservation de la musique avec dispositif électronique : l'intérêt des processus de production sonore", in *Proceedings of Journées d'Informatique Musicale (JIM 2011)*, Saint-Étienne (France), 2011, pp. 71-76.
[12] Hans Tutschku, "*Entwurzelt* (*deracinated*)", *op. cit*.
[13] Hans Tutschku, *Entwurzelt*, *für sechs Sänger und Elektronik*, score, online publication, 2012, www.tutschku.com/download/entwurzelt-score.pdf (last accessed 09/14).
[14] PWGL is a visual programming language for music and sound, widely used for computer-aided composition, based on concepts and ideas similar to the PatchWork software. See for instance Mikael Laurson, Mika Kuuskankare, Vesa Norilo, "An Overview of PWGL, a Visual Programming Environment for Music", *Computer Music Journal*, 33(1), 2009, pp. 19-31.

Starting from the vertical system of these three chords, Hans Tutschku has then used the PWGL software for the computer-aided composition of the horizontal spreading of the structure, both at the macroscopic and microscopic levels:

- at the macroscopic level, PWGL was used to generate the temporal distributions of vocal material and silence for the six voices;
- at the microscopic level, this environment enabled the computation of rhythmic and melodic patterns that filled the vocal locations previously generated.

The lyrics of the singers were also combined within PWGL.

Generating temporal distributions for the voices

In this case, PWGL was used to generate the segmentation of vocal lines, setting both their density and the length of every sung block. Figure 2 shows a simple example of such a process with two voices. These have two opposite behaviours: the upper voice starts with short blocks of singing and long blocks of silence, whereas the lower voice follows a contrary direction. This type of process can easily be generalized to a configuration of six voices.

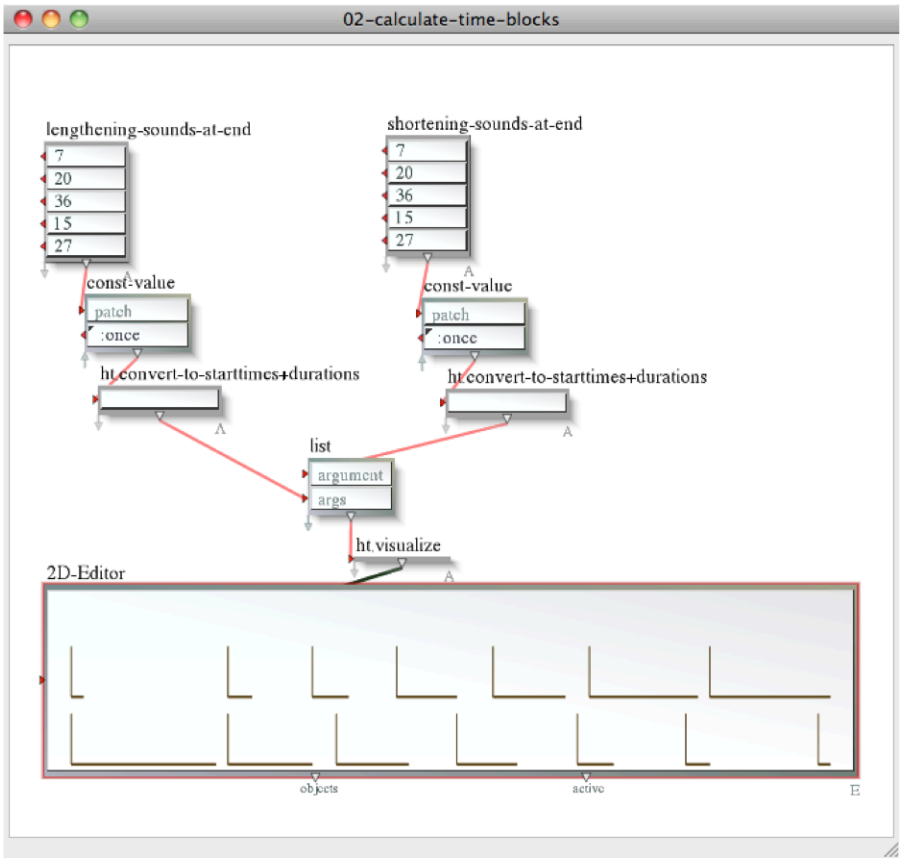

Figure 2. Generating temporal distributions for two voices.
PWGL sketch reproduced by kind permission of Hans Tutschku.

Generating rhythmic and melodic patterns

The next step in computer-aided composition aims at filling the previously generated time blocks with musical material. The first approach proposed by Tutschku consists in spreading a chord onto the six voices. Figure 3 shows how the first of the three main chords of

Entwurzelt is split into intervals of two notes that enable the generation of pulsed tremolos for each voice. A second approach consists in generating random melodic patterns centred on a pitch using a constrained set of transposing intervals.

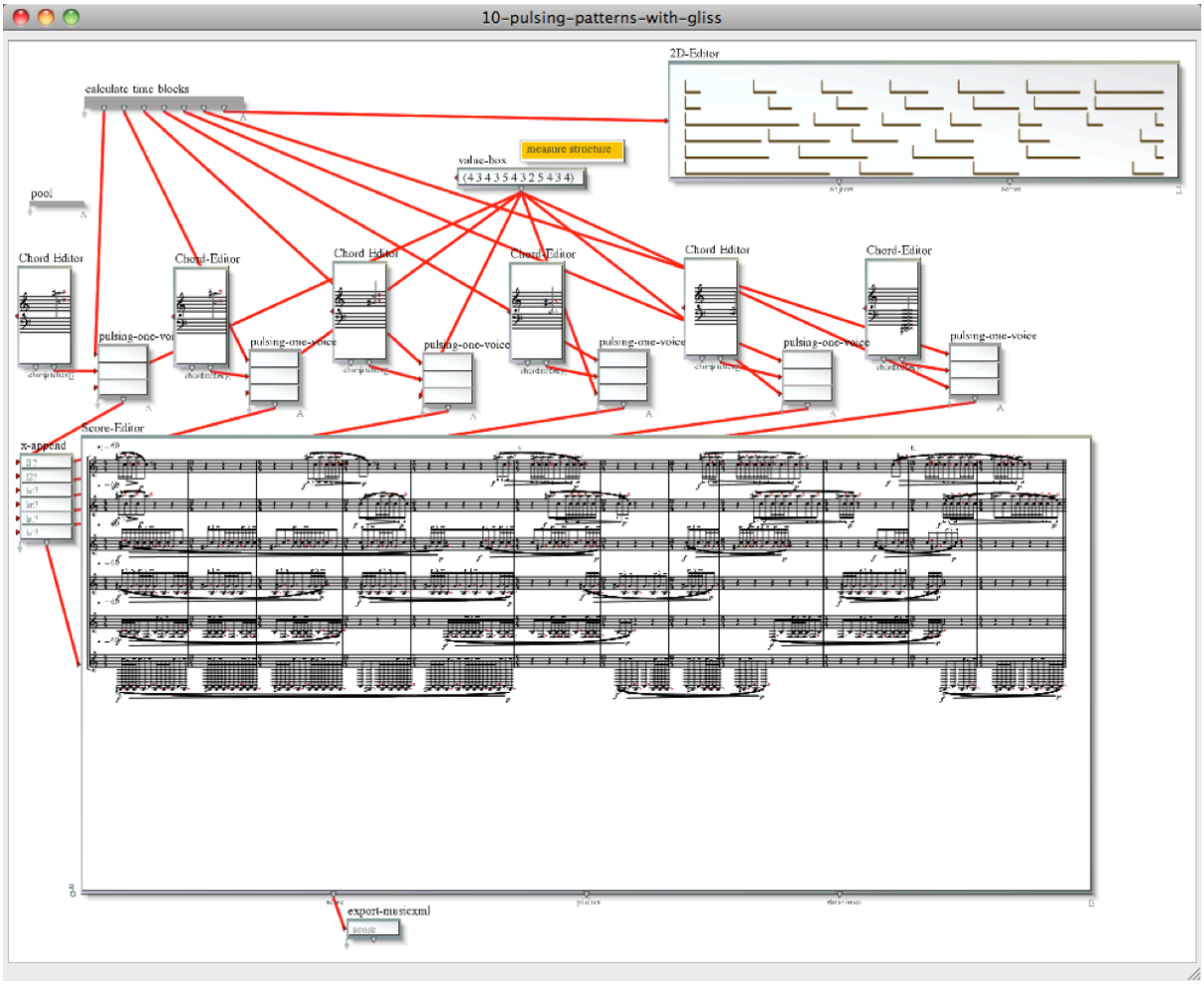

Figure 3. Generating tremolo patterns on sets of two notes extracted from a chord. PWGL sketch reproduced by kind permission of Hans Tutschku.

Generating the lyrics

Tutschku first wrote sentences in various languages from all around the world. He then submitted this collection of sentences to several processes in PWGL: first of all, segmentation and permutation of syllables; then, sorting of the syllables by vowel. For instance, the first section of *Entwurzelt* starts with the 'i' vowel. This process enabled the composer to produce lyrics having no meaning by themselves but a possibly emerging one for listeners.

3. Contextualisation of the sound sources in the structure of *Entwurzelt*

In addition to the 112 sound files constituting the electroacoustic part of *Entwurzelt* as played from the iOS application during a performance, Hans Tutschku provided us with a folder containing 381 sound files corresponding to individual sound tracks that were mixed to form

the final events[15]. 79 of the 112 events are thus documented as sound with a variable number[16] of constitutive elements. For the investigation of these sources, initially ordered linearly by indices of event and individual track, a first stage of organisation and categorisation may lead to an efficient observation of all elements and their relationships. In this matter, the score of *Entwurzelt* contains useful information. The time position of the triggering of each electronic event is unambiguously indicated on an "Elektronik" stave synchronised on the top of the live singers' parts. Along with each numbered event is a textual indication giving a succinct description of the corresponding sound file. From the information contained in the score and the sound files themselves, we have implemented a simple interface[17] that allows for an aural navigation of the events as distributed in the structure of *Entwurzelt*. Figure 4 shows the main panel of this interface with the 112 events spread over the 20 sections of the work.

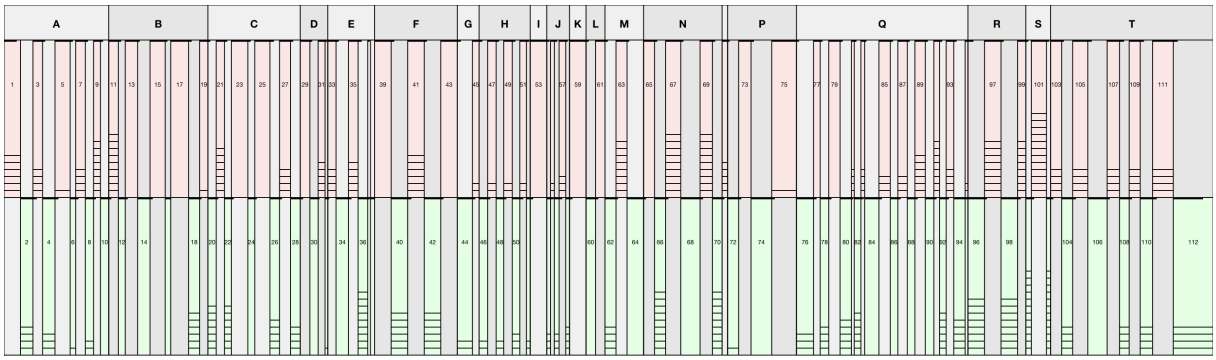

Figure 4. Main panel of the interface for the aural navigation of the electronic events of *Entwurzelt*

On this panel, electroacoustic files are coloured and arranged vertically as in Tutschku's Nuendo session, alternating between red and green for, respectively, odd and even-numbered events. The horizontal axis is that of linear and theoretical time, calculated after the metrics and tempi of the score. Most of the sound files have been composed slightly longer than needed at perfect tempo, so that when the live singers perform slower, the events can run longer until the next one is triggered. In the interface, the coloured regions correspond to the score-based durations; on the top of each block is a thick black line indicating the duration of the sound file itself. The interface does not have the behaviour of a sequencer, playing the sound files linearly from left to right. The user must click on an event to listen to the corresponding file; when clicking on the main body of the event, the final sound file is heard; when clicking in one of the sub-rectangles, the corresponding individual track is played back.

The score textual indications are used to tag each event with keywords and implement a display filter that offers a first level of categorisation of the electroacoustic components of *Entwurzelt*. Different types of information are present in the score texts: harmonic (note names or chord designation), instrumental and vocal ("gong", "bass", "tenor", "soprano", "ensemble"), character related ("animated", "calm"), playing mode related ("arpeggio", "scraped", "scream", "whisper"), or sound processing related ("granulation", "reverb", "reversed"). 32 general keywords and 15 harmonic tags[18] have been inventoried and listed in a separate window that enables to display events that include and/or exclude a specific word

[15] Some reverberation was applied to some of the individual tracks before being mixed.
[16] There are from 1 to 12 individual files for the documented events.
[17] This interface has been developed in Cycling'74 Max using the MGraphics system within Javascript.
[18] The twelve notes of the chromatic scale and "chord 1", "chord 2", "[undefined] chord".

(figure 5). For instance, including only the three chord tags and excluding the keyword "arpeggio" as on figure 5 displays events across sections B, C, D, F, Q and R, all other events being greyed (figure 6). Untoggling the "exclude" box for "arpeggio" would highlight, in addition to the selected events of figure 6, the five events of section F, which are both tagged with "chord" and "arpeggio". Such a filter, based on the indications of the score, enables an

Figure 5. Filter panel with general keywords on the left and harmonic keywords on the right

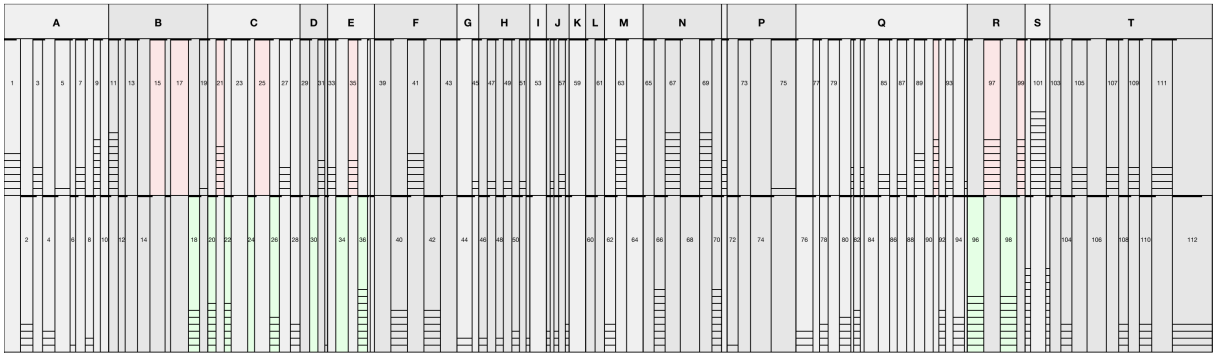

Figure 6. Interface with events including a "chord" keyword and excluding "arpeggio"

efficient investigation of the large set of sound files constituting *Entwurzelt*, as it combines a direct audio access with a structured and categorised visual organisation. The score texts

being indicative and incomplete, the filter should not be in itself regarded as an accurate structural descriptor; it is rather a useful starting point for our approach aiming at establishing genealogies of the sounds constituting the electroacoustic part of the work. The selection of the keyword "glissando", for instance, draws the attention to a common source: a soprano descending glissando that appears similarly in several events of sections B, C, D, and Q[19]. The selection of the keyword "granulation" reveals many events using this process, gathered homogeneously within most of the involved sections: four out of the five events of section F contain "breath-granulation"; all events in sections H, J and L are based on different "staccato ensemble granulation[s]". The three single-event sections of *Entwurzelt*, I, K and O, are tagged with "extreme high staccato ensemble granulation", as well as the three events of section S. The two first events of section S (100, 101) contain sources similar to some of section I, while the third event of S (102) contains sources similar to some of the sounds heard in section K. The last events of section N and first events of section P include "tenor granulation". Out of the twenty events constituting section 20, nine are based on granulation of several different sources: "high soprano granulation", "breath granulation", "staccato granulation", "male voice granulation", "scream granulation". If an inventory of the descriptions used for electroacoustic events can be made on the base of the score on its own, the implementation of our categorised interface allows for an aural exploration of the 381 sources in the context of the structure of *Entwurzelt* and favours the identification of similarities, variations and oppositions amongst these across the global form of the work. Such an exploration will lead, in the forthcoming steps of the collective study undertaken by the *Analysis of Electroacoustic Music* working group, to the establishment of a set of hypotheses for the sources and processes involved in the whole set of individual tracks provided by the composer.

Conclusion

The materials collected for the analysis of *Entwurzelt*, both publically available and provided by Hans Tutschku, constitute useful sources for the consideration of his compositional process on symbolic representations and recorded sound. The first stage of our approach of digital organology applied to this vocal work, presented at the EMS conference in Berlin and in this article, gives a general outline of the composer's creative path and breaks down the studied materials into a set of further questionings that are to be explored in our forthcoming analytical work. The computer-aided composition resources will lead to an attempt to recompose some of the sketches used in PWGL and a modelling that enables an interactive exploration of the construction of macro and microstructures of the work. The sound sources and individual tracks will be the object of an integration within a set of processers that help understanding the relationships between the events distributed through the electroacoustic part of *Entwurzelt*. For both the symbolic and sound domains, the results of this research shall be

[19] In events numbered 19, 27, 32, 91, 94 and 95.

presented both in text and in software, leading to an interactive aural analysis[20] of Tutschku's work. Among the *Analysis of Electroacoustic Music* working group, this approach will be confronted to those presented in Berlin by the other members of our common session, leading to further reflexion on the perspectives opened up by a collective study of a unique electroacoustic work.

Acknowledgements

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[20] As was suggested during the discussion following our talk in Berlin, our approach would benefit from the direct delivery of software, allowing for a direct aural engagement in the creative processes involved in *Entwurzelt*. The concept of interactive aural analysis has been introduced by Michael Clarke at the University of Huddersfield (see Michael Clarke, "Analysing Electroacoustic Music: An Interactive Aural Approach", *Music Analysis*, 31(3), 2012, pp. 347-380), and is currently developed within the TaCEM project involving the first author of this paper (see Michael Clarke, Frédéric Dufeu, Peter Manning, "Introducing TaCEM and the T*IAA*LS Software", in *Proceedings of the 2013 ICMC (International Computer Music Conference)*, Perth (Australia), 2013, pp. 47-53.

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